0. **Defining and Implementing Policy and Strategic Plans.** This function includes the definition, development and implementation of public policies and strategic plans related to ISS research and utilization. Specific functions include organization and execution of boards, panels, working groups and advisory committees involved in the definition of research plans and processes; definition, development and coordination of national and international cooperation; and the organization of forums for planning development of research programs on a strategic global scale within public policy. Policy and plan implementation is distributed across both headquarters and field center organizations.

0. *Define, Develop and Implement Policy and Strategic Plans*
    0.1. *Define Public Policy for ISS Research and Utilization and Develop associated Strategic Plans*
    0.2. *Identify and Allocate Strategic Resources*
    0.3. *Define Inter-Agency and International Utilization Agreements and Barters*
    0.4. *Develop Enterprise Strategies*
    0.5. *Develop ISS Integrated Research Plan*
        0.5.1. *Establish Research Authority*
        0.5.2. *Establish Research Content*
        0.5.3. *Develop U.S. Research Policy*
        0.5.4. *Develop Research Policy for Agreements with International Partners*
        0.5.5. *Develop Policy for Use of Pressurized and Unpressurized Facilities/Resources*
    0.6. *Allocate Resources to Enterprises*
    0.7. *Enterprises Allocate Resources to Research Programs*
    0.8. *Develop Research Themes and Objectives*
    0.9. *Develop and Implement Inter-Agency and International Utilization Agreements and Barters*
    0.10. *Perform Internal/External Advocacy and Coordination*

ISS Utilization Management Concept Development Functional Detail (WBS)
With Inherently Governmental Functions Indicated

1. Management of Research Utilization. This function represents the management of research utilization on the ISS. It includes strategic and tactical implementation of management functions.

1. Management of Research Utilization
    1.1. Establish Research Plans
        1.1.1. Establish Research Program Plans
            1.1.1.1. Implement Research Strategies
            1.1.1.2. Establish Program Requirements
            1.1.1.3. Establish Research Priorities
            1.1.1.4. Identify Program Risks
            1.1.1.5. Establish Program Contingencies
        1.1.2. Negotiate Research Program Agreements and Barters
        1.1.3. Formalize Program/Project Assignments
        1.1.4. Grant Program/Project Authority to Proceed
        1.1.5. Perform Program Assessments
        1.1.6. Identify and Coordinate technology investments
        1.1.7. Provide Research Program Advocacy
        1.1.8. Charter external/internal Evaluations and Review teams
    1.2. Manage Research Programs
        1.2.1. Program Management Coordination and Integration
        1.2.2. Policy and Strategic Planning Support
        1.2.3. Project Authority To Proceed
        1.2.4. Program Reporting
        1.2.5. Budget Planning and Implementation and Integration
        1.2.6. Payload Manifesting and Flight Planning
        1.2.7. Technical Integration Support
        1.2.8. Program Configuration Management
        1.2.9. Mission Integration Support
        1.2.10. Support Ground Operations Integration
        1.2.11. CoFR Process Implementation
        1.2.12. Science Flight Operations Integration
        1.2.13. Coordinate Continuous Improvements/Lessons Learned
    1.3. Manage Integrated Research Utilization
        1.3.1. Integrate MUSS Budgets
        1.3.2. Integrate Budget Threats
        1.3.3. Integrate Program Risk Assessments
        1.3.4. Integrate Development, Flight and Increment Schedules
        1.3.5. Manage MUSS Contracts
        1.3.6. Manage and Support Boards
            1.3.6.1. Payload Control Board
                1.3.6.1.1. Multi-Program Integrated Decision Making
                1.3.6.1.2. Integrated Assessment of ISS Changes for Research Impact
                1.3.6.1.3. Baseline Integrated Manifests
                1.3.6.1.4. Configuration Management of Requirements And Agreements
                1.3.6.1.5. Manage Payload Certification of Flight Readiness (CoFR)
            1.3.6.2. Support Other ISS Program Boards and Panels
                1.3.6.2.1. Report on Payload Issues at ISS Boards and Panels
                1.3.6.2.2. Represent Research Interests at Other Boards and Panels
                1.3.6.2.3. Provide Membership and Advocate Research Issues
                1.3.6.2.4. Assess Changes for Research Impact
            1.3.6.3. Support OBPR Boards
                1.3.6.3.1. Provide Membership to OBPR Boards
                1.3.6.3.2. Report On Payload Issues and ISS Progress/Issues
                1.3.6.3.3. Present And Advocate Integrated Payload Issues and Solutions
                1.3.6.3.4. Present Quarterly Progress

1.3.7.   Support International Partners
    1.3.7.1.   Manage Multi-Lateral Payloads Control Board
        1.3.7.1.1.   Chair MPCB
        1.3.7.1.2.   Multi-Partner Integrated Decision Making
        1.3.7.1.3.   Integrated Assessment of ISS Changes for Research Impact
        1.3.7.1.4.   Baseline Integrated Manifests
        1.3.7.1.5.   Configuration Management Of Requirements And Agreements
    1.3.7.2.   Manage Bartered Payload Hardware
    1.3.7.3.   Manage Payload Interfaces to ISS Bartered Hardware
1.3.8.   Integrate Customer Feedback and Manage/Report Continuous Improvement Activities
1.3.9.   Manage Integrated Payload Flight Operations
1.3.10.   Manage Ground Infrastructure
1.3.11.   Manage Integrated Imagery Services
1.3.12.   Establish and Implement Export Control Policies

2. Preparing and Allocating Budgets. This function includes long-range and fiscal budget formulation, justification and budget execution of ISS research and utilization. Specific functions include budget preparation, legislative consideration and approval, budget execution oversight and reporting, and evaluation of performance.

2.   Preparing and Allocating Budgets
    2.1.   Budget Formulation
        2.1.1.   Long-range Planning
            2.1.1.1.   POP Guidelines Preparation and Issuance
            2.1.1.2.   Center Preparation and Submission
            2.1.1.3.   Program and Enterprise Review
            2.1.1.4.   Administrator Recommendations to OMB
            2.1.1.5.   Budget Trade Studies
        2.1.2.   Fiscal Year Planning
            2.1.2.1.   Operating Plan Preparation and Approval
            2.1.2.2.   Cost Phasing Plan Preparation and Approval
            2.1.2.3.   Budget Change Management
    2.2.   Budget Justification
        2.2.1.   Support Executive Branch Review, Consideration and Approval (for President's Budget)
        2.2.2.   Support Legislative Branch Review, Consideration and Approval (for Appropriation)
    2.3.   Budget Execution
        2.3.1.   Distribution of Funds
            2.3.1.1.   Program Authority
            2.3.1.2.   Resource Authority
        2.3.2.   Accounting
            2.3.2.1.   Accruals
            2.3.2.2.   Disbursement of Funds
            2.3.2.3.   Closeouts
        2.3.3.   Resources Performance Reporting
        2.3.4.   Performance Evaluation
            2.3.4.1.   POP Performance
            2.3.4.2.   Life-Cycle Cost Estimate Performance
            2.3.4.3.   Internal Independent Assessments
            2.3.4.4.   External Assessments and Audits

3. Selecting and Prioritizing Research. This function includes the announcement of research opportunities; operation of non-advocate peer panels in science and corresponding review bodies for technological or commercial projects; programmatic or other evaluations associated with the selection process; and selection / prioritization of experiments, tests, demonstrations, or other research activities on the ISS. This function includes both the investigations and the associated payload manifests to the ISS at the corresponding levels of detail associated with headquarters and field center prioritization and queuing processes. The prioritization function includes determination of national and agency priorities for utilization of the ISS, inclusive of commercial initiatives.

3.   Selecting and Prioritizing Research
    3.1.   Development and Announcement of Research Opportunities (National & International)
        3.1.1.   Educate Potential Proposers
        3.1.2.   Prepare and Issue Announcement
            3.1.2.1.   National
            3.1.2.2.   International
    3.2.   Evaluation of Submitted Proposals (National & International)
        3.2.1.   Feasibility Assessment
        3.2.2.   Correlation with Enterprise Goals
        3.2.3.   Non-Advocate Peer Panel Reviews
        3.2.4.   Non-Advocate Technical Panel Reviews
        3.2.5.   Programmatic Reviews
    3.3.   Selection of Proposals by Selecting Officials and Issuance of Selection Statements[1]
    3.4.   Notification of Selected Research Proposals
        3.4.1.   Notify Selectee
        3.4.2.   Award Grant/Contracts
        3.4.3.   Manage Grant/Contracts
    3.5.   Prioritization of Selected Research Proposals
        3.5.1.   Establishment of Prioritization Criteria
        3.5.2.   Application to Research Projects
        3.5.3.   Application to Payload Manifest
    3.6.   Selection/Approval of other Participants
        3.6.1.   Co-investigators
        3.6.2.   Guest Investigators
    3.7.   Support NASA Agreements with Internationals

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[1] Depends on functions/budget given to the NGO.

4. Establishing Payload/Experiment Requirements and Feasibility. This function defines and documents the payload/experiment requirements necessary to fully accomplish a specific set of research objectives and/or goals. These requirements must be written in sufficient detail to determine the feasibility of successfully completing that investigation with: 1) existing flight experiment hardware, 2) some modification of existing flight experiment hardware, or 3) new flight experiment hardware concepts. In limited cases, these requirements are written to establish the feasibility of providing the capabilities necessary to accomplish a particular range and/or class of experiments through the use of a core facility and experiment unique payloads. When these requirements have been verified as sufficient, they are documented and entered into a program/project configuration management system. This definition covers the Formulation Phase of a project.

4. Establishing Payload/Experiment Requirements and Feasibility
   4.1. Research Requirement Development
      4.1.1. Define basic experiment concept
         4.1.1.1. Experimental Research
         4.1.1.2. Analytical Research
         4.1.1.3. Define preliminary experiment concept
      4.1.2. Scientific Design
         4.1.2.1. Research Requirements Definition
            4.1.2.1.1. Identify research challenges
            4.1.2.1.2. Resolve research challenges
            4.1.2.1.3. Define research requirements
         4.1.2.2. Research Requirements Feasibility Assessment
            4.1.2.2.1. Identify requirements flow between all levels of requirements
            4.1.2.2.2. Develop requirements traceability
         4.1.2.3. Science Requirement Documentation
            4.1.2.3.1. SRD Draft development
            4.1.2.3.2. Conduct Peer Reviews
            4.1.2.3.3. Requirement Updates
            4.1.2.3.4. Final SRD Development and Configuration Control
      4.1.3. Technology Design
         4.1.3.1. Technology Requirements Definition
            4.1.3.1.1. Identify technology challenges
            4.1.3.1.2. Resolve technology challenges
            4.1.3.1.3. Define technology requirements
         4.1.3.2. Technology Requirements Feasibility Assessment
            4.1.3.2.1. Identify requirements flow between all levels of requirements
            4.1.3.2.2. Develop requirements traceability
         4.1.3.3. Technology Readiness-Level (TRL) Documentation
   4.2. Engineering Concept Development
      4.2.1. Engineering Requirements Definition
         4.2.1.1. Science to engineering requirement conversion
         4.2.1.2. Identify engineering challenges
         4.2.1.3. Resolve engineering challenges
         4.2.1.4. Identify Technology Development Requirements
         4.2.1.5. Define Engineering Requirements
      4.2.2. Engineering Requirements Feasibility Assessment
         4.2.2.1. Identify requirements flow between all levels of requirements
         4.2.2.2. Develop requirements traceability
      4.2.3. Engineering Requirement Documentation
         4.2.3.1. Develop ERD Draft
         4.2.3.2. Conduct Engineering Requirements Review
      4.2.4. Engineering Concept Formulation
         4.2.4.1. Develop Systems Engineering Architecture
         4.2.4.2. Develop Engineering Concept Design
            4.2.4.2.1. Develop engineering breadboards

4.2.4.2.2.   Develop Engineering Concept lay-outs/drawings
4.2.4.2.3.   Develop preliminary Interface Definition
4.2.4.2.4.   Safety & Product Assurance
4.3.   Hardware Assessments
   4.3.1.   Conduct Carrier Trade Studies
   4.3.2.   Conduct Experiment Hardware trade studies
      4.3.2.1.   Existing Hardware
      4.3.2.2.   Existing Hardware with Modifications
      4.3.2.3.   New Hardware
   4.3.3.   Develop Draft Interface Agreements

5. Developing Cost, Schedule, and Risk Assessments. This function includes the development of estimates of the costs for Ground and/or Flight Systems needed to satisfy ISS research requirements as well as estimates of when theses systems will be available for deployment and operations. These cost and schedule assessments can involve estimates for accomplishing the research objectives through the use of existing systems, the modification of existing systems, or the development of new systems. NASA will use these estimates during ISS research planning and during the process of approving new system developments. The fidelity of the cost and schedule estimates will be characterized through an assessment of the risks involved in providing the needed systems within the cost estimate and by the estimated deployment date. NASA's need for high fidelity cost and schedule estimates may require risk reduction through technology development/demonstration efforts as a part of the function. This may include work necessary for NASA to estimate pricing and evaluate commercial proposals. This definition covers the Approval Phase of a project.

5. Developing Cost, Schedule, and Risk Assessments
    5.1. Develop Cost Requirements
        5.1.1. Project-Specific Budget Development
        5.1.2. Parametric Cost Estimate Development
    5.2. Develop Project-Level Schedule
        5.2.1. Project Development Schedule
        5.2.2. Ground Processing Schedule
        5.2.3. System Test and Checkout
        5.2.4. Flight/Mission Manifesting Schedule
    5.3. Develop Risk Management Assessment
        5.3.1. Project Specific Risk Assessment
            5.3.1.1. Identify Project-Level Risks
            5.3.1.2. Develop Project Risk Mitigation Strategy
        5.3.2. Risk Mitigation Technology Developments
            5.3.2.1. Identify Possible Risk Reducing Technology Developments
            5.3.2.2. Develop Technology Development Plan
            5.3.2.3. Implement Technology Development Plan
        5.3.3. Risk Management Plan
    5.4. Develop Project Plan
    5.5. Authority to Proceed Review[2]

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[2] Depends on functions/budget given to the NGO.

6. Developing and Qualifying Flight Research Systems. This function represents the design, development, test, integration and evaluation of flight research equipment (i.e. hardware and software) used in the accommodation or operation of research payloads on the ISS, including the preparation of all necessary documentation, configuration control and conduct of qualification and acceptance/certification testing and acceptance procedures, protocols and processes to ensure that all requirement are met. Flight research equipment refers to subrack payloads, facilities, multi-use equipment, etc. For facilities, the activities described below will often include an integrated effort where the facility developer must include and assess inputs from individual subrack payloads to form a part of their facility effort. (See note 1)

6. Developing and Qualifying Flight Research Systems
    6.1. Project Management
        6.1.1. Configuration Management
        6.1.2. Data Management
        6.1.3. Schedule Management
        6.1.4. Financial Management
        6.1.5. Contract Management
        6.1.6. Project Planning
        6.1.7. Project Support
        6.1.8. Risk Management
        6.1.9. Export Control
    6.2. System Engineering
        6.2.1. Requirements Development (US and IP)
            6.2.1.1. Integration Requirements
                6.2.1.1.1. Payload requirements imposed by the Vehicle
                6.2.1.1.2. Payload requirements imposed by the Carrier
                6.2.1.1.3. Payload requirements imposed by the Experiment(s)
            6.2.1.2. Mission Requirements
                6.2.1.2.1. Research Objectives
                6.2.1.2.2. Operations Scenarios
                6.2.1.2.3. Contingency Scenarios
            6.2.1.3. Engineering Requirements
            6.2.1.4. Software Requirements
            6.2.1.5. Requirements Traceability and Flowdown
        6.2.2. Trade Studies and Assessments
        6.2.3. Management Planning
        6.2.4. Interface Control Documents
            6.2.4.1. Payload to Vehicle
            6.2.4.2. Experiment(s) to Payload Carrier
            6.2.4.3. Experiment to Experiment
            6.2.4.4. Experiment to GSE
        6.2.5. Program Integration Documentation
            6.2.5.1. ISS Program Requirements Document
            6.2.5.2. Carrier Usage Agreement(s)
            6.2.5.3. Memoranda of Agreement
            6.2.5.4. Certification Plan
            6.2.5.5. Verification Plan
            6.2.5.6. Structural Verification Plan
            6.2.5.7. Fracture Control Plan
            6.2.5.8. EMI/EMC Plan
            6.2.5.9. SRM&QA Plan
            6.2.5.10. Software V&V Plan
            6.2.5.11. Payload Integration Planning and Data Inputs
                6.2.5.11.1. Basic requirements
                6.2.5.11.2. Payload Data Package

     6.2.5.11.3. Command and Data

     6.2.5.11.4. Crew Compartment

   6.2.5.12. Mass Properties Control Plan

   6.2.5.13. Acoustic Noise Control Plan

   6.2.5.14. Microgravity Control Plan

   6.2.5.15. Human Engineering Plan

   6.2.5.16. Contamination Control Plan

   6.2.5.17. Export Control Documentation

  6.2.6. Systems Reviews

   6.2.6.1. Payload Reviews

     6.2.6.1.1. Design Reviews

     6.2.6.1.2. Flight Reviews

   6.2.6.2. Program Reviews

     6.2.6.2.1. Operations Readiness Reviews

     6.2.6.2.2. Flight Readiness Reviews

  6.2.7. Payload Safety Reviews

   6.2.7.1. Flight Safety

   6.2.7.2. Ground Safety

  6.2.8. GSE/GHE/STE Requirements

  6.2.9. Flight manifest planning and data submission

  6.2.10. PDL and iURC Submissions

 6.3. Design and Development

  6.3.1. Engineering Analysis

   6.3.1.1. Structural and Mechanical Analyses

     6.3.1.1.1. Math Model Development

     6.3.1.1.2. Stress/Fail Safe Analyses

     6.3.1.1.3. Loads Analysis

     6.3.1.1.4. Fracture Analysis

     6.3.1.1.5. Modal Survey

     6.3.1.1.6. Integration Assessments

     6.3.1.1.7. Analyses Reports for Program and Safety panels

   6.3.1.2. Thermal Analyses

     6.3.1.2.1. Active Thermal Control Analyses

       6.3.1.2.1.1. Active Cooling Fluids System Analysis

       6.3.1.2.1.2. Active Heating Analysis

     6.3.1.2.2. Passive Thermal Analyses

       6.3.1.2.2.1. Math Model Development

       6.3.1.2.2.2. TRASYS Analysis

       6.3.1.2.2.3. SINDA Analysis

     6.3.1.2.3. Reports Complete and submit test verified thermal analyses reports and data to Program and the cognizant safety panel

   6.3.1.3. EMI/EMC Analysis and Report Submission

   6.3.1.4. Interface Analyses

     6.3.1.4.1. Electrical and Avionics Analyses

     6.3.1.4.2. Structural and Mechanical Analyses

     6.3.1.4.3. Fluids Analyses

     6.3.1.4.4. Environmental Analyses

     6.3.1.4.5. Software Analyses

     6.3.1.4.6. Vacuum/Venting Analyses

     6.3.1.4.7. Acoustic Analyses

     6.3.1.4.8. Microgravity Analyses

     6.3.1.4.9. Complete, maintain and submit the results of the above analyses.

   6.3.1.5. Safety Analyses

     6.3.1.5.1. Flight Safety Hazards Prep. and Maint.

     6.3.1.5.2. Ground Safety Hazards Prep. and Maint.

     6.3.1.5.3. Retrieval Safety Hazards Prep. and Maint.

   6.3.1.6. Contamination Analyses

- 6.3.1.7. Human Engineering Analyses
- 6.3.1.8. Material Analyses
- 6.3.2. Design Engineering
  - 6.3.2.1. Avionics Design
    - 6.3.2.1.1. Power Design
    - 6.3.2.1.2. Command and Data Handling Design
  - 6.3.2.2. Mechanical Design
  - 6.3.2.3. Electrical and Wire Harness Design
  - 6.3.2.4. Fluid Systems Design
  - 6.3.2.5. Identification of Ground Support Systems (e.g. Trainers)
  - 6.3.2.6. Thermal System Design
  - 6.3.2.7. Detector Design
- 6.3.3. Payload Interface Verification
  - 6.3.3.1. Develop payload verification requirements plan
  - 6.3.3.2. Develop and submit waivers, deviations and exceedences as required
  - 6.3.3.3. Maintain verification closure tracking log
- 6.3.4. Ground and Flight Software Development
  - 6.3.4.1. Requirements Analysis
  - 6.3.4.2. Design
  - 6.3.4.3. Code and Check-out
  - 6.3.4.4. Software Validation
  - 6.3.4.5. Software Verification
  - 6.3.4.6. Independent Verification and Validation
  - 6.3.4.7. Documentation
  - 6.3.4.8. Software Delivery
  - 6.3.4.9. Anomaly Resolution
- 6.4. Manufacturing
  - 6.4.1. Planning
  - 6.4.2. Procurement
  - 6.4.3. Fabrication
  - 6.4.4. Assembly
  - 6.4.5. Closeout Documentation
- 6.5. Subrack Integration
  - 6.5.1. Interface Definition
  - 6.5.2. Interface Agreements
  - 6.5.3. Interface Analyses
  - 6.5.4. Integrated Analyses
  - 6.5.5. Physical Integration and Checkout
- 6.6. Test and Check-out
  - 6.6.1. Developmental testing
  - 6.6.2. Pre-Verification
    - 6.6.2.1. Verification Planning
    - 6.6.2.2. Success Criteria Development
    - 6.6.2.3. Compliance Activities
  - 6.6.3. Qualification/Certification/Verification
    - 6.6.3.1. Functionals
    - 6.6.3.2. Vibration
    - 6.6.3.3. Modal
    - 6.6.3.4. Acoustical Noise
    - 6.6.3.5. Structural Loads
    - 6.6.3.6. Pressure/Leak
    - 6.6.3.7. Weight and C.G.
    - 6.6.3.8. Thermal Vacuum
    - 6.6.3.9. EMI/EMC
    - 6.6.3.10. Off-gassing
  - 6.6.4. Hardware Acceptance
    - 6.6.4.1. Functionals

   6.6.4.2. Workmanship Vibration
   6.6.4.3. Weight and C.G.
   6.6.4.4. Thermal Vacuum
   6.6.4.5. EMI/EMC
   6.6.4.6. Crew Interface and sharp edge inspection
  6.6.5. Test Reports Complete and submit test reports and data.
6.7. Operations
  6.7.1. Flight Operations Planning
   6.7.1.1. Flight Procedure and Display Development
   6.7.1.2. POIC Accommodation Requirements
   6.7.1.3. Command and Data Handling Development
   6.7.1.4. Timeline Requirements
  6.7.2. Training and Simulations
  6.7.3. Flight Operations Execution
   6.7.3.1. On-Orbit Mission Support
   6.7.3.2. Data Retrieval
   6.7.3.3. On-orbit Hardware Retrieval
  6.7.4. Ground Operations, Pre and post flight
   6.7.4.1. Launch Site Accommodations Requirements
   6.7.4.2. Launch Site Procedure Development
   6.7.4.3. Launch Site Test and Checkout Activities
   6.7.4.4. Early/Late Access Activities
  6.7.5. EVA Operations
6.8. Product Assurance
  6.8.1. Reliability
   6.8.1.1. Failure Mode Effects Analysis (FMEA)
   6.8.1.2. Fault Tree Analysis
   6.8.1.3. Critical Items List (CIL)
   6.8.1.4. EEE Parts List
   6.8.1.5. Limited Life Items List
   6.8.1.6. Irregular Parts List (IPAR)
   6.8.1.7. Review Certification Plan
  6.8.2. Maintainability
  6.8.3. Quality Assurance
   6.8.3.1. Quality Engineering
   6.8.3.2. Inspections
   6.8.3.3. Preparation and Maintenance Data Pack
   6.8.3.4. Material and Processes Usage Analysis
6.9. Logistics
  6.9.1. Logistics Planning
  6.9.2. Integrated Analysis
  6.9.3. Sparing and Maintenance Plan
  6.9.4. Shipping and Receiving
  6.9.5. Depot and Bonded Storage Maintenance
  6.9.6. Inventory

7. Maintaining and Sustaining Flight Research Systems. This function represents the maintenance, operations and sustaining engineering of flight research systems (e.g. facility payloads, EXPRESS Racks, EXPRESS Pallet) through upgrades, replacement, or spares. It represents the recurring costs associated with Function 6.

7.   Maintaining and Sustaining Flight Research Systems
   7.1.   Project Management
      7.1.1.   Configuration Management
      7.1.2.   Data Management
      7.1.3.   Schedule Management
      7.1.4.   Financial Management
      7.1.5.   Contract Management
      7.1.6.   Risk Management
      7.1.7.   Project Planning
      7.1.8.   Project Support
      7.1.9.   Logistics Planning
   7.2.   System Engineering
      7.2.1.   Requirements Definition
      7.2.2.   Trade Studies and Assessments
         7.2.2.1.   Sparing and Maintenance Plan
      7.2.3.   Interface Control Documents
      7.2.4.   Program integration Documentation
      7.2.5.   Test and Check-out
      7.2.6.   Systems Reviews
      7.2.7.   Safety Analysis Reports (SARs)
      7.2.8.   GSE/GHE/STE Requirements
      7.2.9.   Flight manifest planning and data submission
   7.3.   Design and Development
      7.3.1.   Engineering Analysis
      7.3.2.   Design Engineering
   7.4.   Manufacturing
      7.4.1.   Planning
      7.4.2.   Procurement
      7.4.3.   Fabrication
      7.4.4.   Assembly
   7.5.   Operations
      7.5.1.   Operations Planning
      7.5.2.   Flight Operations
      7.5.3.   Pre and Post-flight Ground Operations
      7.5.4.   Training and Simulations
      7.5.5.   EVA Operations
   7.6.   Ground and Flight Software Development
      7.6.1.   Requirements Analysis
      7.6.2.   Design
      7.6.3.   Code and Check-out
      7.6.4.   Software Validation
      7.6.5.   Software Verification
      7.6.6.   Independent Verification and Validation
      7.6.7.   Documentation
      7.6.8.   Software Delivery
      7.6.9.   Anomaly Resolution
   7.7.   Product Assurance
      7.7.1.   Safety
      7.7.2.   Reliability
      7.7.3.   Maintainability
      7.7.4.   Quality Assurance

7.8. Logistics and Maintenance
    7.8.1. Integrated Analysis
    7.8.2. Shipping and Receiving
    7.8.3. Depot and Bonded Storage Maintenance
    7.8.4. Inventory
    7.8.5. Spare, Repair or Refurbish

8. Developing Ground Systems. This function represents development of all multi-user, discipline-specific and experiment-unique ground systems necessary to support the successful operation of the flight research systems. It includes all associated systems, subsystems, components or other related items (e.g. communications, data processing, data analysis equipment, GSE, training hardware and simulators) necessary to the ground program. This function excludes the development of ground systems that also serve non-ISS programs and projects. This function represents those major systems that have a non-recurrent cost. (See Note 1)

8. Developing Ground Systems
    8.1. Define Research Ground Systems
        8.1.1. Identify all Flight Systems
        8.1.2. Support project reviews for Flight Systems
        8.1.3. Define Requirements for Research Ground Systems
        8.1.4. Define concept of operation, e.g., pre-flight, during flight, post flight, ongoing
    8.2. Project Management
        8.2.1. Planning and Scheduling
        8.2.2. Budget and Resources
        8.2.3. Metrics development and tracking
        8.2.4. Documentation Management
        8.2.5. Test, Validation, Quality Assurance and Certification Management
        8.2.6. Training Management
        8.2.7. Project Reviews, Reporting and Approval
        8.2.8. Configuration Control
        8.2.9. Security
    8.3. Develop Research Ground Systems
        8.3.1. Develop Detailed Requirements, Technical Specifications and Requirements Tracibility
        8.3.2. Perform trade and feasibility studies on COTS systems
            8.3.2.1. Analysis of COTS functionality
            8.3.2.2. Requirements trace between user and COTS functionality
            8.3.2.3. COTS integration and test
            8.3.2.4. COTS availability and cost factors
        8.3.3. Develop System/Subsystem Architectures and Designs and a Detailed Operational Concept
        8.3.4. Define Infrastructure Support required
        8.3.5. Conduct formal reviews for systems and subsystems as required
        8.3.6. Perform System and Subsystem tests
    8.4. Deploy Research Ground Systems
        8.4.1. Identify capabilities required to operate systems
        8.4.2. Personnel Training
            8.4.2.1. Hardware maintenance and operation
            8.4.2.2. Software maintenance and operation
            8.4.2.3. Mission specific operations
        8.4.3. Perform Operational System Tests and Simulations
            8.4.3.1. Telemetry
            8.4.3.2. Video
            8.4.3.3. Voice
            8.4.3.4. Commanding
            8.4.3.5. Planning
            8.4.3.6. Networking
            8.4.3.7. Mission specific operations
        8.4.4. Verify that Ground Research Systems properly support Flight Systems and meet Research Requirements
            8.4.4.1. Conduct Flight Readiness Reviews
            8.4.4.2. Conduct System Certification

9. Maintaining and Sustaining Ground Systems. This function represents the maintenance, operations, and sustaining engineering of multi-user, discipline-specific and experiment-unique ground systems or equipment (e.g. communications, data processing, data analysis equipment, GSE, training hardware and simulators). It represents the recurring costs associated with Function 8. This function excludes maintaining and sustaining ground systems that also serve non-ISS programs and projects.

9.   Maintaining and Sustaining Ground Systems
   9.1.   Identify changes/upgrades of equipment and/or procedures to current Research Flight Systems
      9.1.1.   Support all new experiment and payload reviews
      9.1.2.   Support all post-flight briefings and "lessons learned"
      9.1.3.   Evaluate and Identify the need for changes/upgrades to Research Ground Systems
      9.1.4.   Determine resources to implement changes (manpower, facilities, time)
   9.2.   Maintain Research Ground Systems
      9.2.1.   Ground Support Services
         9.2.1.1.   Operational and Facility Planning
         9.2.1.2.   System Operations Personnel Training
            9.2.1.2.1.   Provide training to systems equipment operators (locally and remotely)
            9.2.1.2.2.   Provide training (as needed) to experiment researchers
         9.2.1.3.   Provide Support to Real-Time Operations
         9.2.1.4.   Facility Operations
      9.2.2.   User Support Services
         9.2.2.1.   Systems Configuration
         9.2.2.2.   Help Desk
         9.2.2.3.   Systems Troubleshooting
         9.2.2.4.   Reconfiguration for Specific Missions
         9.2.2.5.   Telemetry Processing
         9.2.2.6.   Data Archiving
      9.2.3.   Systems Management
         9.2.3.1.   Networks
         9.2.3.2.   Data Systems
         9.2.3.3.   Communication Systems
         9.2.3.4.   Command and Control Systems
         9.2.3.5.   Computational Systems
         9.2.3.6.   Database Administration
         9.2.3.7.   Configuration and Change Control
         9.2.3.8.   Network Management
      9.2.4.   Maintain Procedures and Training
         9.2.4.1.   Maintain and update procedures and processes, as required
         9.2.4.2.   Ensure all OSHA and site safety requirements are addressed
         9.2.4.3.   Provide training for hardware and software sustaining engineering and maintenance
      9.2.5.   Provide and maintain system performance metrics
   9.3.   Sustain Research Ground Systems
      9.3.1.   Change Management
         9.3.1.1.   Evaluate user and system requirements for potential system impact
         9.3.1.2.   Validate changes to ensure proposed changes meet requirements
         9.3.1.3.   Implement upgrades/modifications to systems, subsystems, components and/or procedures
         9.3.1.4.   Maintain Configuration Control, including documentation, of the upgrades to Research Ground Systems
      9.3.2.   Perform Logistics for the Research Ground Systems
         9.3.2.1.   Procure and maintain "spares" inventory based on need and lessons learned
         9.3.2.2.   Procure and maintain service contracts for systems equipment
         9.3.2.3.   Maintain and document Systems and/or Equipment calibration

9.3.3. Maintain HW/SW and operational security
      9.3.3.1. Security planning and analysis
      9.3.3.2. Risk identification and mitigation
      9.3.3.3. Network and System hardware and software unique security
9.3.4. Provide mission specific planning and operations to include hardware/software performance impacts analysis and mission specific reconfigurations

10. Constructing Ground Facilities. This function represents major acquisitions in terms of buildings, laboratories and test facilities, including initial outfitting of capital equipment (e.g. overhead cranes, lab benches, autoclaves, hoods) and furniture, associated with multi-user and discipline-specific ISS research and utilization. This function may include construction of ISS-specific portions of facilities that also serve non-ISS programs and projects and represents major acquisitions that have a non-recurrent cost.

10. Constructing Ground Facilities
  10.1. Identification
      10.1.1. Needs and Benefits Analysis
      10.1.2. Requirements Development
      10.1.3. Coordination and Approval of Requirements
      10.1.4. Request for Authority to Proceed
  10.2. Planning
      10.2.1. Pre-project Planning
      10.2.2. Partnering
      10.2.3. Site investigation and definition
      10.2.4. Environmental Assessment and Impact Definition
      10.2.5. Risk Assessment
  10.3. Budgeting
      10.3.1. Cost Development
      10.3.2. Economic Analysis
      10.3.3. Project Approval Document Development
      10.3.4. Reporting
  10.4. Management
      10.4.1. Transition Planning
      10.4.2. Project Reviews and Approval
      10.4.3. Configuration Control
  10.5. Design
      10.5.1. Requirements Assessment
      10.5.2. Engineering Studies
      10.5.3. Site/Architectural Plans
      10.5.4. Design Reviews and Approval
  10.6. Construction
      10.6.1. Construction Oversight and Monitoring
      10.6.2. Construction Phasing and Integration
      10.6.3. Building Commissioning, Activation and Turnover

11. Maintaining Ground Facilities. This function represents the maintenance, operations, and sustaining engineering associated with buildings, laboratories, and test facilities for multi-user and discipline-specific ISS research and utilization (e.g. Control Centers, Telescience Centers). This function may include maintaining ISS-specific portions of facilities that also serve non-ISS programs and projects. It represents the recurring costs associated with Function 10.

11. Maintaining Ground Facilities
    11.1. Management and Administration
        11.1.1. Materials and Consumables
        11.1.2. Safety
        11.1.3. Training
        11.1.4. Certification
        11.1.5. Facility Schedules Coordination
    11.2. Consolidated Maintenance
        11.2.1. Housekeeping
        11.2.2. Electrical
        11.2.3. Mechanical
        11.2.4. Plumbing
        11.2.5. Information Technology
            11.2.5.1. Networks
            11.2.5.2. Data Systems
            11.2.5.3. Communication Systems
            11.2.5.4. Command and Control Systems
            11.2.5.5. Computational Systems
            11.2.5.6. Databases
        11.2.6. Contamination Control
    11.3. Sustain Ground Facilities
        11.3.1. Evaluate potential modifications to Facilities
        11.3.2. Ensure proposed changes meet requirements
        11.3.3. Implement upgrades/modifications to Facilities
        11.3.4. Maintain service contracts for Facility Equipment
        11.3.5. Maintain Facility Equipment calibration
        11.3.6. Maintain Configuration Control of the upgrades to Facilities
        11.3.7. Logistics (inventory, spares, etc.)

12. Certifying Safety of Research Flight and Ground Systems. This function represents the assessment of payload safety at the system, subsystem, component, and sample/specimen levels, including the safety of procedures, protocols and processes associated with payload, or experiment, transportation, accommodation or operations. This function includes safe design, manufacture, verification, and operation. It also includes preparation and presentation of safety data packages, including integrated safety data packages for a compliment of payloads or experiments. The responsibility for final approval of safety will remain with NASA.

12. Certifying Safety of Research Flight and Ground Systems
    12.1. Project and Integrated Ground Safety
        12.1.1. Assess Hazards Definitions
            12.1.1.1. Critical
            12.1.1.2. Catastrophic
            12.1.1.3. Integrated
        12.1.2. Assessment of Hazards (Payload Developer P/Ls)
            12.1.2.1. Evaluate hazard reports with control measures
            12.1.2.2. Evaluate hazard analyses as needed (PHA, OHA, FMEA)
            12.1.2.3. Evaluate special safety studies, as needed
            12.1.2.4. Review presentation to the GSRP
            12.1.2.5. Evaluate safety verifications and/or review closure of safety verifications
            12.1.2.6. Identify ground support equipment design requirements
                12.1.2.6.1. Conduct Safety Assessment of GSE
            12.1.2.7. Review unique documentation for Re-flown and Series Payload hardware
        12.1.3. Evaluate operations
            12.1.3.1. Review Launch Site Safety Plan
            12.1.3.2. Assess handling and transport constraints
            12.1.3.3. Review operational procedures
            12.1.3.4. Review Failure Tolerance
            12.1.3.5. Assess Hazardous Operations
            12.1.3.6. Assess Safety Inspections
            12.1.3.7. Assess use of tools/equipment
        12.1.4. Safety Panel Review and Approval
            12.1.4.1. Assess Payload Complexity
                12.1.4.1.1. Define Process level required
            12.1.4.2. Conduct Phase Reviews, as appropriate
            12.1.4.3. Track open safety action items
            12.1.4.4. Track open verification items
            12.1.4.5. Provide Ground Safety Certification letter
            12.1.4.6. Provide Ground Integrated Cargo Hazard Assessment Report Completion letter
    12.2. Project and Integrated Flight Safety (Payload Developer P/Ls)
        12.2.1. Audit Safety Data
            12.2.1.1. Ensure comprehensive identification of hazards on hazard reports
            12.2.1.2. Ensure identification of appropriated hazard control
            12.2.1.3. Ensure identification of associated hazard control verifications
            12.2.1.4. Ensure timely closure of hazard control verifications
            12.2.1.5. Evaluate on-orbit operations
            12.2.1.6. Conduct Safety Reviews
                12.2.1.6.1. Sign Hazard Reports
                12.2.1.6.2. Issue action items as appropriate and track to closure
                12.2.1.6.3. Conduct associated Technical Interchange Meetings, as appropriate
        12.2.2. Certify Hardware for Flight Readiness
            12.2.2.1. Ensure timely receipt of Safety Certificate
            12.2.2.2. Issue CoFR statement, along with supporting rationale
        12.2.3. Support Flight Operations
            12.2.3.1. Provide support during all mission phases (ground, launch, on-orbit, return), as appropriate or required

12.2.3.2.   Address safety anomalies

13. Managing Missions and Allocating Services. This function includes the definition and commitment of services between the end-user, or payload developer, and the Agency in order to ensure timely production of all user hardware, software and documentation deliverables in accordance with pre-agreed milestones. This function also includes the planning, integrating, and scheduling and of all user-related activities necessary for successful multilateral utilization of the space station in flight or on the ground in pre and post-flight periods. User related activities include: (1) transportation assignments to launch vehicles; (2) physical accommodation assignments to the space station user accommodation elements, and; (3) operating period assignments on the space station with corresponding resource allocations for crew time, energy, data transmission and any unique resources specific to individual user activities. In order to plan, integrate and schedule these critical user activities efficiently and effectively on a multilateral basis, the mission management function is also responsible for directing the orderly performance and timely completion of all remaining principle functions which are on the critical path to user transportation, accommodation and operations. In cases where joint program commitments are required among the station partners in order to transport, accommodate, or operate user elements, this activity includes the negotiation of joint program documents and management of the implementation phase. (See Footnote [3])

13. Managing Missions and Allocating Services
    13.1. Management, Reporting, Advocacy and Administration
        13.1.1. Support ISS Assembly Sequence Analyses with regard to research
        13.1.2. Advocate enhancement of resources
        13.1.3. Maintain ISS User's Guide
        13.1.4. Maintain & report research metrics
        13.1.5. Maintain ISS User requirements documents
            13.1.5.1. Concept of Operations & Utilization, Appendix C
            13.1.5.2. Research Requirements Doc.
        13.1.6. Track and Integrate Risks related to research requirements
        13.1.7. Evaluate and track ISSP and Shuttle change requests that affect research
            13.1.7.1. Collect and integrate impacts from research programs
            13.1.7.2. Advocate user impacts to ISSP and Shuttle boards and panels
            13.1.7.3. Report final disposition/decision to user community
        13.1.8. Support ad hoc ISSP or OBPR sponsored reviews
        13.1.9. Integrate and Represent requirements for Multi-use Hardware
            13.1.9.1. WORF
            13.1.9.2. EXPRESS Racks and Pallets
            13.1.9.3. MELFI, Cryo and conditioned stowage assets
        13.1.10. Provide Export Control Consolidation and Policy
    13.2. Allocate Services for ISS Research Missions and Increments
        13.2.1. Develop and Maintain analytical models of ISS research resources and capabilities
            13.2.1.1. Characterize limiting resources
            13.2.1.2. Perform modeling of resource usage and optimization
        13.2.2. Obtain Resource Requests from Payload Developers
        13.2.3. Obtain Resource Requests from International Partners
        13.2.4. Consolidate Requests
        13.2.5. Prioritize Requests
        13.2.6. Manage Allocations to Programs and Partners
        13.2.7. Publish and maintain Multi-Lateral Payload Outfitting Model
        13.2.8. Negotiate Allocations from ISS
        13.2.9. Perform Discipline Integration

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[3] **Note:** The Earth and Space Science enterprises select and fund their research independent of the ISS program, Therefore, a NGO would be limited to a support role for functions 6, 8, 13, and 16 for these enterprises, Further, function 20, as it relates to Earth and Space Science, meets the criteria for functions to be retained by NASA or Principal Investigators (PIs), with no option to transfer.

13.2.9.1.   Develop integrated requirements
13.2.9.2.   Represent discipline to ISSP boards and panels
13.2.9.3.   Represent ISSP capabilities to outside working groups
13.2.9.4.   Support feasibility assessments for PI selections
13.2.9.5.   Manage ISSP microgravity working group activities
13.2.9.6.   Represent Code M payloads to ISSP
13.2.9.7.   Support ISSP Commercial payload activities
13.2.10.   Perform strategic/tactical/execute level resources analyses
13.2.10.1. Evaluate Level 1 strategic plan against tactical capabilities
13.2.10.2. ISS Level Analyses
13.2.10.3. Research Program level analyses
13.2.11.   Develop flight/increment planning documentation
13.2.11.1. ISS Level Analyses
13.2.11.2. Research Program level analyses
13.2.12.   Negotiate, Approve and Allocate Services
13.2.12.1. Negotiate services with PD and ISSP
13.2.12.2. Allocate services
13.2.12.3. Approve services
13.2.12.4. Baseline Increment Complements
13.2.13.   Perform Increment Science Integration
13.3.   ISS Research Mission Management
13.3.1.   Management of Payload Integration
13.3.1.1.   Manage SPIP Vol, 1 & 2 Payload Integration responsibilities
13.3.1.2.   Negotiate Partner Roles and Support for Payload Integration
13.3.1.3.   Manage bartered hardware integration
13.3.1.3.1.   Agreements in Principle
13.3.1.3.2.   Joint Implementation Plans
13.3.1.4.   Approve Payload Tactical Plans
13.3.1.5.   Approve Integration Agreements
13.3.1.6.   Support ISSP Fleet resources management activities
13.3.1.7.   Manage Payload Operations Interface to ISSP
13.3.1.7.1.   Networks
13.3.1.7.2.   Displays
13.3.1.7.3.   Graphics
13.3.1.7.4.   Training
13.3.1.7.5.   Operations Data File
13.3.1.7.6.   International Partner Operations Centers
13.3.1.8.   Manage real-time flight support
13.3.1.9.   Report progress to ISSP and OBPR
13.3.2.   Develop and Maintain Schedules, Integration Agreements and Data Sets
13.3.2.1.   Maintain mission integration template
13.3.2.2.   Develop and maintain mission integration schedules
13.3.2.3.   Maintain generic payload integration agreements
13.3.2.3.1.   Pressurized Payloads
13.3.2.3.2.   Small Payloads
13.3.2.3.3.   EXPRESS Rack Payloads
13.3.2.3.4.   WORF Rack payloads
13.3.2.3.5.   Unpressurized payloads
13.3.2.4.   Develop and maintain payload unique integration agreements
13.3.2.5.   Approve payload unique integration agreements
13.3.2.6.   Maintain generic data sets
13.3.2.7.   Develop and maintain payload specific data sets
13.3.2.8.   Approve payload specific data sets
13.3.2.9.   Support development of IP integration documentation
13.3.2.10. Ensure consistency of subrack/subpallet integration agreements with rack/pallet
agreements
13.3.3.   Develop and Manage Integrated Payload Mission (flight and increment)

13.3.3.1. Provide integrated payload interface and products to Launch Package and increment Management Team

13.3.3.2. Identify and resolve payload mission issues with Mission Management, Increment Management, and Launch Package levels

13.3.3.3. Provide console training requirements for real-time support

13.3.4. Facilitate Payload Integration

13.3.4.1. Provide interface design data to PD

13.3.4.2. Negotiate integration and interface documents with ISSP and PD

13.3.4.3. Negotiate data set related services with PD and ISSP

13.3.4.4. Negotiate technical requirements and technical services

13.3.4.5. Negotiate schedule deliveries

13.3.4.6. Report discrepancies/inconsistencies

13.3.4.7. Ensure implementation of PD requirements by ISSP

13.3.4.8. Coordinate and status open work

13.3.4.9. Coordinate close of Level 1 PRACA issues

13.3.4.10. Support major PD design, safety, and acceptance reviews

13.3.4.11. Ensure all data sets are correctly implemented in PDL

13.3.5. Provide increment/flight definition and payload detailed manifests

13.3.5.1. Coordinate and compile allocations, manifests, GR&C, requirements, and topology

13.3.5.2. Develop and Maintain Payload Tactical Plan Blank Book

13.3.5.3. Develop increment payload tactical plan

13.3.5.4. Integrate US and Partner requirements into ISSP

13.3.5.5. Develop and manage increment integrated schedules

13.3.5.6. Perform manifest tracking

13.3.5.7. Identify and resolve increment issues at Mission Management, Increment Management, and Requirements Integration Panel levels

13.3.5.8. Perform stowage integration assessments

13.3.5.9. Develop and integrate payload pre-pack and transfer requirements

13.3.5.10. Perform Russian payload data integration

13.3.5.11. Perform payload data integration into launch vehicle and ISS

13.3.5.12. Support Increment Operations Readiness Reviews, Launch Package Assessments, Stage Operations Readiness Reviews

13.3.5.13. Support Flight/Stage reviews, ISSP control boards & panels, TIMs, WGs, etc.

13.3.6. Manage Certification of Flight Readiness (CoFR) for Research

13.3.6.1. Maintain generic CoFR process

13.3.6.2. Perform flight/increment unique CoFR

13.3.6.3. Research Program unique CoFR

13.3.6.4. Project unique CoFR

13.3.6.5. Represent Research at Program CoFR

13.3.7. ISS Research Mission Execution

13.3.7.1. Coordinate and manage increment research team

13.3.7.2. Execute real-time research tradeoffs

13.4. Post Flight Activities

13.4.1. Post Flight Reporting

13.4.1.1. Lessons Learned

13.4.1.2. Crew Debrief

13.4.1.3. Gather and Publish Post Mission Reports

14. Integrating User Missions—Analytical. The purpose of analytical integration to ensure safe and functional hardware and software interfaces. The 'user' side of the interface may be an experiment, a payload, or a payload complement. The 'operator' side of the interface may be the crew, a rack, a pallet, an ISS laboratory module, an exposed facility, launch vehicle(s), ground operations center(s); any of which may belong to one or more International Partners. Functions necessary to ensure safe and functional interfaces include: negotiation of Interface Control Documents, development of interface verification plans, certification of interface verification procedures, analyses and/or testing to support interface verification, analyses and/or testing to support verification, safety and compatibility of a complement of payloads, development and certification of complement-unique software configurations, development of operational constraints, and real-time support for anomaly resolution.

14. Integrating User Mission – Analytical
   14.1. Management Integration
      14.1.1. Participate in Program-level Boards and Panels
      14.1.2. Manage Payload-specific Analytical Integration Boards and Panels
      14.1.3. Assign products and issues to appropriate teams and report out to ISS boards and panels
      14.1.4. Management reporting
      14.1.5. Evaluate program changes to identify payload impacts
      14.1.6. Support periodic independent reviews
      14.1.7. Identify, collect and integrate payload data products for ISS Program Reviews
         14.1.7.1. CoFR
         14.1.7.2. Increment Operations Reviews
         14.1.7.3. Launch Package Assessment Reviews
         14.1.7.4. Stage Operations
         14.1.7.5. Readiness Reviews
   14.2. Payload Engineering Integration
      14.2.1. Interface Requirements and Verification
         14.2.1.1. Maintain Interface Requirements Documentation
            14.2.1.1.1. Integrated Rack
            14.2.1.1.2. Utility Outlet
            14.2.1.1.3. EXPRESS Rack
            14.2.1.1.4. WORF
            14.2.1.1.5. Attached Payload
               14.2.1.1.5.1. EXPRESS Pallet
               14.2.1.1.5.2. JEM EF
               14.2.1.1.5.3. Truss
               14.2.1.1.5.4. Columbus EPF
            14.2.1.1.6. EXPRESS Sub-Pallet
         14.2.1.2. Develop and Maintain Hardware Interface Control Documents
            14.2.1.2.1. Integrated Rack
               14.2.1.2.1.1. US Lab
               14.2.1.2.1.2. JEM
               14.2.1.2.1.3. Columbus EPF
               14.2.1.2.1.4. MPLM
               14.2.1.2.1.5. CAM
            14.2.1.2.2. Utility Outlet
            14.2.1.2.3. EXPRESS Rack
            14.2.1.2.4. WORF
            14.2.1.2.5. Attached Payload
            14.2.1.2.6. EXPRESS Sub-Pallet
         14.2.1.3. Support assessment of non-standard payload Interface Control Document changes
         14.2.1.4. Maintain Verification Requirements Documentation
            14.2.1.4.1. Integrated Rack
            14.2.1.4.2. Utility Outlet
            14.2.1.4.3. EXPRESS Rack

14.2.1.4.4. WORF
14.2.1.4.5. Attached Payloads
    14.2.1.4.5.1. EXPRESS Pallet
    14.2.1.4.5.2. JEM EF
    14.2.1.4.5.3. Truss
    14.2.1.4.5.4. Columbus EPF
14.2.1.4.6. EXPRESS Sub-Pallet
14.2.1.5. Develop Integrated Verification Plan
    14.2.1.5.1. Status, track and verify closure of individual pl developer verification requirements
    14.2.1.5.2. Support payload developer in providing data for integrated analyses
    14.2.1.5.3. Recommend disposition for NASA closure of payload verification
    14.2.1.5.4. Present integrated results at program reviews
14.2.1.6. Develop and maintain payload flight equipment requirements and guidelines for safety critical structures
14.2.1.7. Develop and maintain the payload verification program plan
14.2.1.8. Maintain payload handbooks
    14.2.1.8.1. Pressurized payload handbook
    14.2.1.8.2. Attached payload handbook
    14.2.1.8.3. EXPRESS Rack payload handbook
    14.2.1.8.4. EXPRESS Pallet payload handbook
    14.2.1.8.5. WORF Payload handbook
14.2.1.9. Support design review and data pack review for major payloads

14.2.2. Safety
14.2.2.1. Assist payload developer in processing waivers, deviations and exceedences and evaluate and recommend NASA closure
14.2.2.2. Review and analyze payload safety data packages
14.2.2.3. Coordinate with ISS Safety Review Panel and the Payload Safety Review Panel
    14.2.2.3.1. Evaluate integrated payload hazards
    14.2.2.3.2. Develop recommended updates to NSTS 1700.7B Addendum
    14.2.2.3.3. Develop recommended PSRP interpretation letters
    14.2.2.3.4. Evaluate and recommend payload safety non-compliance reports
14.2.2.4. Perform payload complement hazard analyses and develop and present integrated safety data packages and system and stage configurations
14.2.2.5. Maintain payload interface fault tolerance document including any unique hazard controls for EXPRESS Rack, WORF and EXPRESS Pallet
14.2.2.6. Develop models for coupled loads analyses and verification loads analyses for EXPRESS Racks and EXPRESS Pallets
14.2.2.7. Review and support payload planning activities and topology and compatibility analyses

14.2.3. Rack Level/Element Level/ISS Level Analyses
14.2.3.1. Maintain tools and models to perform integrated facility rack level, complement level and integrated station level analyses for each stage
14.2.3.2. Perform payload complement level analyses for US and IP modules and truss system to ensure compatibility
    14.2.3.2.1. Structures (loads and physical)
    14.2.3.2.2. Dynamics
    14.2.3.2.3. Microgravity
    14.2.3.2.4. Mass properties
    14.2.3.2.5. Momentum
    14.2.3.2.6. C&DH
    14.2.3.2.7. C&T
    14.2.3.2.8. Thermal (active and passive including sensible and latent loads)
    14.2.3.2.9. Fields of view
    14.2.3.2.10. Power availability
    14.2.3.2.11. Stability
    14.2.3.2.12. Channelization

14.2.3.2.13. EMI/EMC
14.2.3.2.14. Acoustic noise
14.2.3.2.15. Contamination and material usage
14.2.3.2.16. Vacuum exhaust
14.2.3.2.17. Vacuum resource
14.2.3.2.18. Shock
14.2.3.2.19. Particulates
14.2.3.2.20. Radiation
14.2.3.2.21. Fire detection and suppression
14.2.3.2.22. Internal clearances
14.2.3.2.23. EVR clearances for payloads
14.2.3.2.24. EVA translation paths around payloads
14.2.3.2.25. Human factors
14.2.3.2.26. Nitrogen
14.2.3.2.27. Oxygen usage
14.2.3.2.28. CO_2 levels

14.2.3.3. Perform capability assessment for preliminary operational guidelines and constraints
    14.2.3.3.1. L-18
    14.2.3.3.2. Final
14.2.3.4. Perform on-call, near real-time payload safety analyses to support reconfigurations or anomaly troubleshooting on orbit
14.2.3.5. Develop and maintain for each stage, integrated drawings/schematics of the on-board payload complement
14.2.3.6. Develop payload transfer keep-alive power scenarios
14.2.3.7. Perform cargo integration analyses
14.2.3.8. Perform Shuttle middeck analyses on ISS payload complement
14.2.3.9. Perform on-orbit transfer operations analyses on ISS payload complement

14.3. Payload Software Integration and Flight Production
  14.3.1. Maintain software interface requirements documents
    14.3.1.1. Integrated Rack
    14.3.1.2. Utility Outlet
    14.3.1.3. EXPRESS Rack
    14.3.1.4. WORF
    14.3.1.5. Attached Payload
    14.3.1.6. EXPRESS Sub-Pallet
    14.3.1.7. Develop and Maintain Software Interface Control Documents for ISS payloads
      14.3.1.7.1. Integrated Rack
        14.3.1.7.1.1. US Lab
        14.3.1.7.1.2. JEM
        14.3.1.7.1.3. Columbus EPF
        14.3.1.7.1.4. MPLM
        14.3.1.7.1.5. CAM
      14.3.1.7.2. Utility Outlet
      14.3.1.7.3. EXPRESS Rack
      14.3.1.7.4. WORF
      14.3.1.7.5. Attached Payload
      14.3.1.7.6. EXPRESS Sub-Pallet
    14.3.1.8. Manage and maintain other associated ICD software documents
    14.3.1.9. Manage and maintain payload support PCS displays
    14.3.1.10. Manage and maintain payload product integrated list and payload integrated flight loads
    14.3.1.11. Manage and maintain payload MDM Users Manual
    14.3.1.12. Support assessment of non-standard payload software Interface Control Document changes
    14.3.1.13. Support the PDL C&DH data set development
    14.3.1.14. Develop, maintain and provide payload ancillary data to the mission build facility

14.3.1.15. Integrate payload avionics and software products to program boards

14.3.1.16. Develop, maintain and implement the PSIV System Development Plan

14.3.1.17. Perform on-call, near real-time payload safety analyses to support reconfigurations or anomaly troubleshooting on orbit

14.3.1.18. Perform payload software integration for the payload complement for each stage

14.3.1.19. Develop and maintain complement test plans/procedures/reports for payload software and deliver certified payload software to the program

14.3.1.20. Perform integrated payload complement assessments for payload flight software for increment payload complement verification

14.3.1.21. Develop and document integrated payload software related processes and data flows including problem reports, change notices and other program documentation

14.3.1.22. Provide software configuration management of the as flown configurations

14.3.1.23. Develop and maintain the Payload Software Management Plan

15. Integrating User Missions – Physical. This function includes the physical buildup, testing, validation/ verification of functional interfaces, specialized science processing, and integration of experiments, payloads, or payload complements during the ground processing phase in preparation for launch to the ISS. This function also includes physical deintegration of experiments and payloads at the landing site.

15. Integrating User Missions - Physical
    15.1. Management
        15.1.1. Budget development and administration
        15.1.2. Procurement
        15.1.3. Certificate of Flight Readiness (COFR)
        15.1.4. Safety and Mission Assurance
        15.1.5. Configuration Control
    15.2. Planning
        15.2.1. Pre-planning for Payload Processing
        15.2.2. Development of Ground Utilization Requirements
            15.2.2.1. Technical requirements
            15.2.2.2. Configuration requirements
            15.2.2.3. Support requirements
            15.2.2.4. Ground Application Software Requirements
        15.2.3. Operations and Schedule Development Process
        15.2.4. Work Authorization Document Development Process
    15.3. Off-Line Processing
        15.3.1. Requirements definition for Off-Line Processing Area (OLPA)
        15.3.2. Off-Line Processing Support
             15.3.2.1. GSE and Checkout Offline Processing Maintenance (PRCU)
        15.3.3. Unassigned OLPA Maintenance
            15.3.3.1. Facility Maintenance
            15.3.3.2. Test Equipment Maintenance and Calibration
        15.3.4. Specialized Science Processing
            15.3.4.1. Preparations for Arrival
                15.3.4.1.1. Identification and Presentation of OLPA Requirements
                15.3.4.1.2. Off-Line Laboratory Assignments and Use of the Specialized Science Support Facilities
                15.3.4.1.3. Pre-arrival Laboratory Preparations
            15.3.4.2. Pre-Flight Operations
                15.3.4.2.1. Payload Hardware Testing and Checkout
                15.3.4.2.2. Integration
            15.3.4.3. In-Flight Operations
            15.3.4.4. Post-Flight Operations
                15.3.4.4.1. Remote Landing Site Support
                15.3.4.4.2. Post-Flight Analysis
                15.3.4.4.3. Laboratory Clearance
                15.3.4.4.4. Shipping Logistical Support
    15.4. Hardware Receiving
    15.5. Flight Hardware Turnover
    15.6. Physical Integration and Closeouts
        15.6.1. Equipment
        15.6.2. Payload Stowage
        15.6.3. Mechanical Integration
    15.7. Test and Checkout Operations
        15.7.1. Pre-Test Preparations
            15.7.1.1. Checkout System and GSE
            15.7.1.2. User Room
        15.7.2. Payload Functional Interface Test

15.7.3.   Post-Test Activities
15.8. SSPF Integrated Operations
    15.8.1.   Payload Installation, Stowage, Servicing, and Closeouts
15.9. Orbiter Integrated Operations
    15.9.1.   Servicing and Closeouts
    15.9.2.   Late Stowage
    15.9.3.   Launch Delay
    15.9.4.   Postlanding
        15.9.4.1.   Nominal Post-Landing Processing
        15.9.4.2.   Intact Abort
        15.9.4.3.   Early End of Mission
        15.9.4.4.   Middeck Post-Landing Operations
        15.9.4.5.   Early Destowage
15.10. Deintegration
    15.10.1. Equipment
    15.10.2. Payload Destow/Turnover
    15.10.3. Flight Hardware Between-Mission Maintenance
15.11. Other Launch Vehicle Integrated Operations

16. Integrating User Missions – Operational. This function includes the near real-time activity conducted at payload and station operations centers. This includes short term planning and replanning, contingency planning, and responses to unplanned events associated with or otherwise affecting the ISS research program at all levels. Payload training activities are also included in this function. (See Note 1)

16. Integrating User Missions - Operational
    16.1. Utilization Operations Concept
        16.1.1. Requirements Derivation and Coordination
        16.1.2. Processes Definition and Integration
        16.1.3. Payload Operations Plan Development
    16.2. Management and Administration
        16.2.1. Integrated Utilization Schedules Coordination
        16.2.2. Coordinate and consolidate Metrics Package
        16.2.3. Maintain Action Item Database
        16.2.4. Perform Configuration Management for Payload Operations
        16.2.5. Support Program Reviews
    16.3. Systems Requirements Assessments and Verification
        16.3.1. Command Systems
        16.3.2. Payload Support Systems
        16.3.3. Data Systems and Databases
        16.3.4. Voice and Video Systems
        16.3.5. Planning and Scheduling Systems
        16.3.6. Procedure and Display Systems
        16.3.7. Ground Networks
        16.3.8. Control Centers Functional Requirements
        16.3.9. Control Centers Interface Requirements
        16.3.10. Assess PRs, SPRs, SPNs, PIRNs, ECRs, CEFs, CRs for Impact to Operations
    16.4. Operations Capability Development
        16.4.1. Crew Procedures (Manual and Automated)
        16.4.2. Displays
        16.4.3. Computations and Scripts
        16.4.4. Timeliner
        16.4.5. Develop, Manage and Maintain Special-Purpose Areas to Develop and Verify Operations Products
          16.4.5.1. PODF Production Facility
          16.4.5.2. DUET lab
          16.4.5.3. Video Lab
    16.5. Payload Operations Development
        16.5.1. Flight Rule Review and Input
        16.5.2. Payload Regulations Development
        16.5.3. Joint Operations Integration Procedures Development
        16.5.4. Payload Operations Handbook Development
    16.6. Payload Program Planning
        16.6.1. Perform Payload Operations Feasibility Assessments
        16.6.2. Assess On-orbit Payload Topologies
        16.6.3. Assess Plug-In Plans
    16.7. Operations Preparation
        16.7.1. Payload Training
          16.7.1.1. Perform Payload Crew Training
          16.7.1.2. Develop and Conduct Payload Simulations
          16.7.1.3. Develop and Administer Ground Support Personnel Training
        16.7.2. Payload Procedures
          16.7.2.1. Develop and Maintain Crew Procedures
          16.7.2.2. Perform PODF Procedures Verification
            16.7.2.2.1. Standards

        16.7.2.2.2.   Useability

        16.7.2.2.3.   With Displays

16.7.2.3.   Integrate, Build and Verify Payload Procedures into Flight, Training and Simulation Libraries

16.7.2.4.   Provide Interface for ODF Standards and Nomenclature

16.7.3.   Payload Planning and Scheduling

    16.7.3.1.   Develop and Implement NASA and IP Processes

    16.7.3.2.   Collect, Assess and Coordinate ETOV Payload Requirements

    16.7.3.3.   Collect, Assess, Coordinate and Model PD Payload Planning Requirements

    16.7.3.4.   Develop and Integrate Increment-specific Planning Products

16.7.4.   Payload Command and Data Management

    16.7.4.1.   Develop and Implement NASA and IP Processes

    16.7.4.2.   Collect, Assess and Coordinate PD Payload Operations Requirements

    16.7.4.3.   Integrate Requirements for Ancillary and Payload Health and Status Data

    16.7.4.4.   Assess and Integrate Payload Stowage and Logistics Requirements

    16.7.4.5.   Assess and Coordinate Payload Rack and/or Pallet to System Interfaces

    16.7.4.6.   Support KSC Payload Integration Testing

    16.7.4.7.   Test and Verify Displays, Comps and Scripts via PSIV-F and Flight Database

16.7.5.   Payload Safety Analysis

    16.7.5.1.   Review Payload Safety Data Packages

    16.7.5.2.   Support the PSRP and Participate in Independent Safety Verification Reviews

    16.7.5.3.   Develop and Maintain the Payload Operations Hazard Database

    16.7.5.4.   Develop and Maintain the Integrated Toxicology Database

16.7.6.   Payload Operations Integration

    16.7.6.1.   Develop and Integrate PD and Control Center Requirements

    16.7.6.2.   Develop and Implement Facility Transition Plan per Flight

    16.7.6.3.   Validate Flight Database

    16.7.6.4.   Manage CoFR Implementation

16.7.7.   Integrated Payload Operations Products

    16.7.7.1.   On-Orbit Summary (OOS)

    16.7.7.2.   Short-Term Plan (STP)

    16.7.7.3.   Increment File Set

    16.7.7.4.   TV/Photo Operations Book

    16.7.7.5.   Payload Operations Data File (PODF)

    16.7.7.6.   Automated Procedures

16.8. Operations Execution

   16.8.1.   Real-Time Operations

   16.8.2.   Operations Replanning

   16.8.3.   Weekly Planning

   16.8.4.   Contingency Operations

16.9. Post-Operations Analysis

   16.9.1.   Post-Flight Imagery Review

   16.9.2.   Post-Mission Lesson Learned Reviews

   16.9.3.   Continuous Process Improvement Activities

17. Conducting Research & Analysis and Disseminating Results. This function represents the work of the principal investigator in scientific endeavors, or the project investigator in technological or commercial endeavors, that is directed toward the achievement of research objectives. The investigator specifically leads the development of requirements and objectives for the research, undergoes appropriate research review, is involved in the experiment procedure development and on-board real-time research operations, conducts analysis of the data and/or samples, prepares operational reports, compares results to objectives, submits research reports, provides input to the archiving process, and participates in research conferences to report and discuss results to the research community.

17. Conducting Research & Analysis and Disseminating Results
    17.1. Conceptualize the investigation
        17.1.1. Define the investigation research requirements
        17.1.2. Conduct ground-based tests and analyses required to support the investigation design
        17.1.3. Develop research requirements document for individual investigations and research requirements envelope document for facility level projects
        17.1.4. Undergo appropriate non-advocate reviews
        17.1.5. Support project plan development with research requirements and measurable objectives inputs
        17.1.6. Support risk management plan development
        17.1.7. Support determination of investigation feasibility, technology challenges, and logistical issues
        17.1.8. Plan resource requirements as needed
        17.1.9. Develop breadboards to perform experiments in support of the research
    17.2. Design and Develop the Experiment
        17.2.1. Develop research plan, schedule and resources for PI activities, including data requirements/dissemination
        17.2.2. Review hardware capabilities and interface documentation for compliance/compatibility with the research requirements
        17.2.3. Support formal hardware reviews
        17.2.4. Verify that the hardware and the mission operations will adequately support the research requirements
            17.2.4.1. Support hardware and mission safety reviews
            17.2.4.2. Participate in mission working groups and review mission activities to verify that mission operations will adequately support the research requirements
        17.2.5. Validate adequacy of crew training to meet research requirements
        17.2.6. Support operations product development as appropriate
        17.2.7. Support mission simulations as appropriate
        17.2.8. Develop measurable mission success criteria for the experiment
        17.2.9. Prioritize mission success criteria; reiterate need for use of the space environment
        17.2.10. Assign roles, responsibilities and data rights to co-investigators
        17.2.11. Perform ground experiments in support of the research
    17.3. Implement the experiment
        17.3.1. Support ground processing
            17.3.1.1. Provide research support to hardware integration and testing as appropriate
            17.3.1.2. Provide research preparation for flight as appropriate
        17.3.2. Support Ground and Flight Safety Reviews (Provide safety/toxicological information as required)
        17.3.3. Support research mission operations
        17.3.4. Support retrieval of research hardware and data samples (as required)
        17.3.5. Provide experiment samples and/or sample modules/containers as required
        17.3.6. Perform ground experiments in support of the research (i.e. ground controls)
    17.4. Evaluate experiment results and compare to objectives
        17.4.1. Receive and process data
        17.4.2. Analyze data
    17.5. Report on the experiment results and other reporting
        17.5.1. Prepare 30-day operational accomplishment report
        17.5.2. Submit a one-year research report

17.5.3. Publish results in refereed scientific journals or commercial/business publications
17.5.4. Participate in post-one-year research conferences to report and discuss results to the research community
17.5.5. Provide inputs to the archiving process
17.5.6. Provide inputs to and review of press releases, mission press kits, mission briefings, program brochures, program web sites, and other material for informational/educational activities
17.5.7. Identify commercial applications of the research
17.5.8. Comply with Export Control Regulations and Requirements

18. Educating and Reaching Out to the Public (including industry). This function includes the development, dissemination and evaluation of information to the public through a wide variety of methods in order to educate and broaden awareness of the ISS program and its associated benefits and to inspire the next generation of explorers.

18. Educating and Reaching Out to the Public (including industry).
   18.1. Management and Control
      18.1.1. Develop Outreach and Education strategic plan
      18.1.2. Develop ISS Research themes and messages
      18.1.3. Evaluate and assess effectiveness of Outreach and Education programs
      18.1.4. Coordinate with NASA Public Affairs and Education Offices to ensure consistency of materials and synergy among activities
      18.1.5. Maintain an inventory of all ISS research outreach and education materials and projects
      18.1.6. Approve plans, themes and messages
   18.2. Disseminate flight and ground-based ISS research results to ISS customers
      18.2.1. NASA publications and Web Pages (e.g, Task Books)
      18.2.2. External peer-reviewed journals and trade publications
      18.2.3. Public media events and popular press publications
   18.3. Communicate ISS technologies and innovations to private industry and the public sector
      18.3.1. Targeted industry outreach
      18.3.2. Public outreach events, publications, Web Pages
      18.3.3. Provide opportunities for the public's active participation in ISS research
      18.3.4. Science and technology museum programs
   18.4. Support national education goals
      18.4.1. Science, mathematics and technology related educational materials
         18.4.1.1. K-12 Level
         18.4.1.2. College/University/Institute Level
      18.4.2. Educator in-service and professional development workshops
      18.4.3. Educational exhibits, conferences and events

19. Recommending ISS Pre-Planned Product Improvements. This function represents the user community recommendations and priorities for improvement of ISS productivity through upgrades, changes, or additions to the ISS spacecraft systems, elements, and/or processes which enhance the quality or quantity of user accommodations or operations, this supports the broader P^3I objectives of the Program.

19. Recommending ISS Pre-Planned Product Improvements
    19.1. Establish Payload Scenario Options for Future ISS Utilization
    19.2. Identify ISS Resource Limits Impacting Utilization
        19.2.1. Spacecraft Systems
        19.2.2. Elements
        19.2.3. Processes
    19.3. Support Determination of ISS Improvement Requirements for Enhanced Research Scenarios
        19.3.1. Requirements Determination
            19.3.1.1. Crew Time
            19.3.1.2. Electrical Power
            19.3.1.3. Logistics Support
            19.3.1.4. Flight Control Team Operations Support Efficiency
            19.3.1.5. Training
            19.3.1.6. Communications, Data, Tracking Supportability
            19.3.1.7. Experiment Accommodations
            19.3.1.8. ISS Natural and Induced Environment for Crew and Experiments
            19.3.1.9. Life Support Capability
            19.3.1.10. Habitability
            19.3.1.11. Transportation to and from ISS
        19.3.2. Requirements Compatibility Assessment
    19.4. Support Assessment and Prioritization of ISS Enhancements to Meet ISS P^3I Objectives
        19.4.1. Performance
        19.4.2. Operations
        19.4.3. Technology Readiness Level
        19.4.4. Life Cycle Cost
        19.4.5. Schedule
        19.4.6. Safety Risk
        19.4.7. Integrated Prioritization
    19.5. Determine, Document and Communicate Lessons Learned from all Phases of Development and Operations

20. Managing Archival of Research Samples, Data and Results. This function represents the management of ground archiving of research products in accordance with established processes for future use in an accessible manner that ensures preservation of information. The function also includes facilitating and enabling the distribution of results. Research samples, data and results that are proprietary in nature will continue to be maintained by the industrial sponsor. (See Note 1)

20. Managing Archival of Research Samples, Data, and Results
    20.1. Archive Management and Control
        20.1.1. Archive Management Plan
        20.1.2. Content Identification, Review and Approval Process
    20.2. Archive Capability Development
        20.2.1. Requirements Definition
        20.2.2. Capability Development
            20.2.2.1. Functional capabilities
            20.2.2.2. Physical archive
        20.2.3. Maintenance & Preservation
    20.3. Archive Operations
        20.3.1. Data receipt and storage
            20.3.1.1. Inspect Data
            20.3.1.2. Categorize Data
            20.3.1.3. Check Data quality
            20.3.1.4. Data trend studies
            20.3.1.5. Store Data
        20.3.2. Sample receipt and storage
            20.3.2.1. Inspect Samples
            20.3.2.2. Categorize Samples
            20.3.2.3. Check Samples quality
            20.3.2.4. Samples trend studies
            20.3.2.5. Store Samples
        20.3.3. Data/ Sample Accountability
            20.3.3.1. Data/ Sample tracking
            20.3.3.2. Data/ Sample status
    20.4. Archive Accessibility and Dissemination
        20.4.1. Accessibility
            20.4.1.1. Content Index
            20.4.1.2. Search and Locate
                20.4.1.2.1. Results
                20.4.1.2.2. Data
                20.4.1.2.3. Samples
        20.4.2. Dissemination
            20.4.2.1. Request
            20.4.2.2. Review and approval
            20.4.2.3. Response to request
            20.4.2.4. Track proprietary data agreements